

Free-body diagrams and net force problems

AP Physics 1 (algebra-based) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and is worth 20 points. Use $g = 9.81 \text{ m/s}^2$, show all working and give units. Draw free-body diagrams wherever they help.

Level: AP Physics 1 (algebra-based) · **Curriculum:** AP P1 Unit 2

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Newton's first law (2 marks)

- State Newton's first law. (1 mark)
- A car moves at a steady 20 m/s on a straight road. State the net force on it and explain how you know. (1 mark)

Question 2 Net force calculation (3 marks)

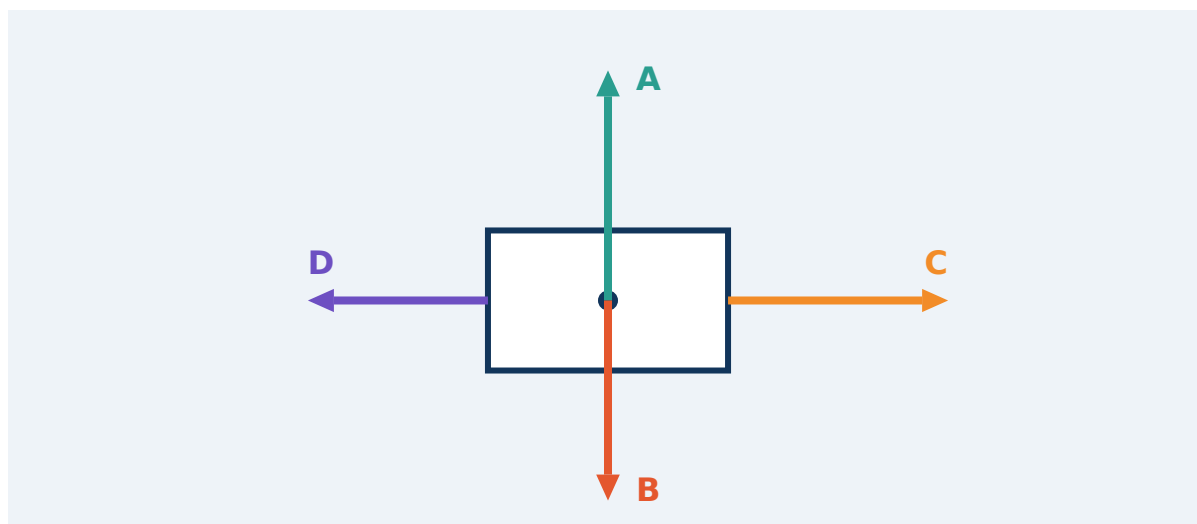
A 900 kg car accelerates from rest to 18 m/s in 6.0 s.

- Calculate its acceleration. (1 mark)
- Calculate the net force on the car. (2 marks)

Question 3 Reading a free-body diagram (3 marks)

The figure shows a crate pushed to the right on a rough floor at constant velocity.

- Identify the forces A, B, C and D. (2 marks)
- State the relationship between C and D, and explain. (1 mark)



Free-body diagram of a crate pushed to the right.

Question 4 Third-law pairs (2 marks)

A swimmer pushes the water backward with her hands and moves forward.

- State the third-law partner of the force of her hands on the water. (1 mark)
- Explain which of the two forces accelerates the swimmer. (1 mark)

Question 5 Elevator problem (4 marks)

Kofi, 60 kg, stands on a scale in an elevator that accelerates downward at 1.5 m/s^2 .

- Calculate his weight. (1 mark)
- Calculate the scale reading. (2 marks)
- State the scale reading when the elevator moves down at constant velocity. (1 mark)

Question 6 Pulling two blocks (3 marks)

A 10 N horizontal force pulls a 1.5 kg block, which is connected by a light string to a 0.50 kg block, on a smooth table.

- Calculate the acceleration of the blocks. (1 mark)
- Calculate the tension in the string. (2 marks)

Question 7 Mass and weight (1 mark)

State whether the mass or the weight of an astronaut changes when going from Earth to the Moon, and give the reason. (1 mark)

Question 8 Rocket in empty space (2 marks)

A rocket in deep space fires its engine and speeds up. Explain this using Newton's third law.
(2 marks)